An Exploratory Study of Cardiac Synchrony and Joint Engagement in Parent-Child Dyads of Autistic and Neurotypical Children

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Background

- Cardiac synchrony is the coordination of heart activity between two people during social interaction.
- **Heart rate variability (HRV)** is a measure of cardiac function and adaptability.
- Studies comparing children with autism (ASD) and neurotypical (NT) peers show mixed results but often report **reduced physiological synchrony in ASD**.[1]
- Understanding patterns of cardiac synchrony could inform biomarker identification and social intervention development for ASD.

Objectives

1. Compare HRV trend and concurrent synchrony of parent-child dyads with and without ASD during play.
2. Examine whether HRV trend and concurrent synchrony predict parent-child joint engagement (JE).

Methodology

Participants

- 6 ASD and 12 NT parent-child dyads engaged in free play.

Data

- **JE**: 'Supported' (SJE) and 'Coordinated' (CJE) JE based on the *State-Based Joint Engagement* coding scheme.[2]
- **SRS**: *Social Responsiveness Scale (2nd Ed.)* severity level
- **Proximity**: Parent-child distance via video-based pose[3] and depth estimation.[4]
- **HRV Coherence**: Low-frequency (LF; 6.7–25 sec) and high-frequency (HF; 2.5–6.7 sec) wavelet coherence of normalized HRV root mean square of successive differences (RMSSD).

Models

- Linear mixed-effects regression modeling average LF and HF HRV coherence

$$\text{Coherence}_{ij} = \beta_0 + \beta_1 \text{Dx}_i + \beta_2 t_{ij} + u_{\text{Dyad}[i]} + \varepsilon_{ij}$$

- Bayesian mixed-effects multinomial logistic regression predicting SJE and CJE

$$\log\left(\frac{\Pr(\text{JE}_i = j)}{\Pr(\text{JE}_i = 0)}\right) = \beta_0^{(j)} + \beta_1^{(j)}\text{Dx}_i + \beta_2^{(j)}\text{Gender}_i + \beta_3^{(j)}\text{SRS}_i + \beta_4^{(j)}\text{Proximity}_i + \beta_5^{(j)}\text{Coherence}_i + u_{\text{Dyad}[i]}$$

Results

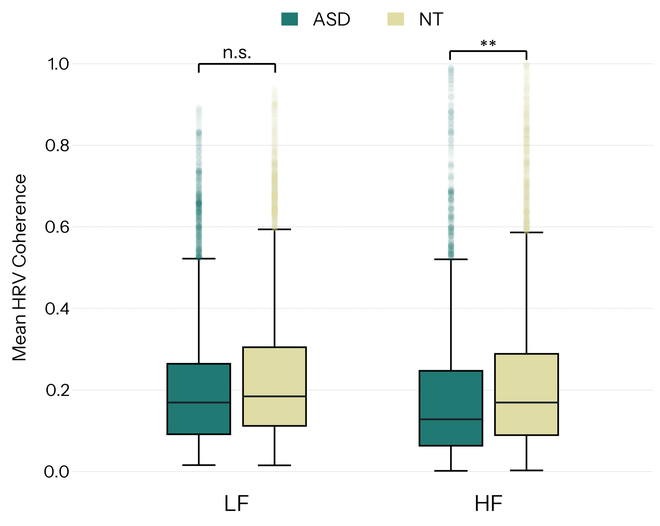

Figure 1. Mean LF and HF coherence between groups

NT toddlers show greater HF coherence with their parents than autistic toddlers (β = .035, p = .01, Cohen's d = .21).

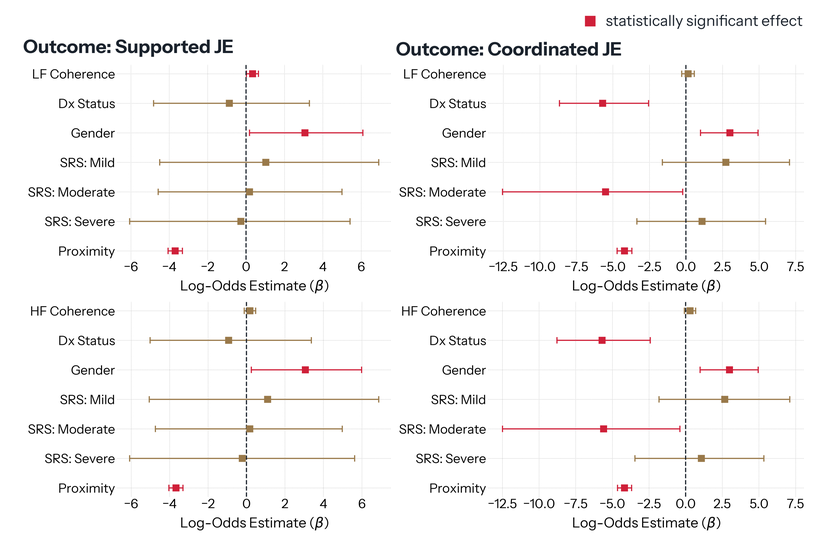

Figure 2. Log-odds estimates of joint engagement predictors

Reduced proximity and being a girl are associated with greater odds of both SJE and CJE. ASD diagnostic status predicts lower odds of CJE.

Conclusions

- Neurotypical toddlers show greater HRV concurrent synchrony with their parents than autistic toddlers.
- HRV trend synchrony shows a modest association with supported joint engagement, highlighting its potential role in relational attunement alongside contextual factors such as proximity and gender.

Supplementary Material

Abstract

References